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PETROLOGICAL ABSTRACTS AND REVIEWS

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SCHLOSSMACHER, K. "Die Sericitgneise des rechtsrheinischen Taunus," *Jahrb. d. Preuss. Geol. Landesanst., f. 1917*, XXXVIII (1919), Th. 1, 374-433, pl. 1, figs. 2.

The sericite-gneisses of the Taunus are dynamo-metamorphosed quartz-keratophyres and felse-keratophyres. Ten chemical analyses are given, of which four are new. A general description and a discussion of the chemical relationships are followed by descriptions of the various localities.

SCHLOSSMACHER, K. "Ein Verfahren zur Herrichtung von schiefen und lockeren Gesteinen zum Dünnschleifen," *Centralbl. f. Min. Geol., etc.*, 1919. Pp. 190-92, fig. 1.

The usual method of boiling porous and schistose rock fragments in Canada balsam is not efficient. Here is described an apparatus by means of which the pore spaces in the rock may be filled with balsam. A tube with a stoppered side opening is partially filled with balsam, placed in a water bath, and the air exhausted. Any time thereafter chips to be sectioned are placed in the side tube, the air is exhausted, the tube is tilted so that the chip falls into the balsam where it is left until the bubbles cease.

SCHLOSSMACHER, K. "Keratophyre und ihre dynamometamorphen Äquivalente aus der Umgegend von Bad Homburg im Taunus," *Jahrb. d. Preuss. Geol. Landesanst. f. 1919*, XL (1920), Th. 1, 460-505.

The metamorphic rocks of the Taunus are keratophyres and soda-keratophyres; tuffs were nowhere found. Detailed petrographic descriptions and two new chemical analyses are given.

SCHLOSSMACHER, K. "Einige nichtmetamorphe paläovulkanische Eruptivgesteine aus dem Vordertaunus," *Zeitschr. d. Deutsch. Geol. Gesell.*, LXXII (1920), 25-27.

Unmetamorphosed paleovolcanic albite-trachytes and trachy-andesites, that is, keratophyres and keratophyre-porphyrates, are described from eight

localities. The phenocrysts are usually albite, in two occurrences orthoclase with intergrown albite; the groundmass is trachytic albite with small amounts of magnetite, chlorite, and a little sericite.

SCHNEIDERHÖHN, H. "Die Methoden zur mikroskopischen Untersuchung kristallisierter Körper," *Handbuch der mikroskopischen Technik*, Stuttgart, X (1914), 45-94, figs. 68.

Gives a brief but very good summary of petrographic-microscopic methods, well illustrated by figures. Attention is called to the fact that these methods are applicable not only to the determination of rocks, but that they may be used in the determination of natural and artificial salts, synthetic minerals, cement, etc.

SCHNEIDERHÖHN, HANS. "Über Methoden, um rasch und einfach aus Photographien Strichzeichnungen herzustellen," *Senckenbergiana*, I (1919), 190-93, figs. 2.

While this is not a petrographic article, the method here given for rapidly reproducing photographs may be of interest to petrographers, especially in these days of poor print-paper. A developing-paper print of the thin section or other petrographic subject is "inked-in" with waterproof ink. It is then immersed in subdued light for a few minutes in acid hypo, and then, without washing, placed in a rather concentrated solution of about equal parts copper sulphate and potassium bromide. In a few minutes the silver image will become altered to a yellowish image of silver bromide. When of a yellow color, it is washed for a few moments and re-immersed in the hypo until the yellow color disappears and leaves a white background. Without first immersing in hypo the operation is somewhat slower. Instead of copper sulphate, potassium ferricyanide may be used. A second method, less desirable on account of the poisonous nature of the material, but more rapid, is to dissolve the silver in a dilute solution of potassium cyanide. The print should be thoroughly washed afterward.

SCHNEIDERHÖHN, HANS. "Die mikroskopische Untersuchung undurchsichtiger Mineralien und Erze im auffallenden Licht und ihre Bedeutung für Mineralogie und Lagerstättenkunde," *Neues Jahrb.*, B. B. XLIII (1920), 400-438.

Here is a most excellent summary of work done on the determination of opaque minerals by means of incident light under the microscope. A long bibliography is given.

SCHNEIDERHÖHN, HANS. "Beiträge zur Kenntnis der Erzlagerstätten und der geologischen Verhältnisse des Otaviberglandes, Deutsch-Südwestafrika," *Abhandl. d. Senckenbergischen Naturf. Gesell.*, XXXVII (1921), 221-321. Figs. 16, figs. 40 in photo-gravure, and colored map 1.

The greater part of this report is economic and geologic. Only a few igneous rocks are mentioned, namely, aplite, olivine and mica kersantites, and microgranite. The aplite occurs in a dike-like mass widening into lens-shaped masses in several places. It is cut by the younger kersantite. The microgranite forms a laccolite intruded between strata of the dolomite, and in all probability was derived from the same source as the aplite which may represent the channels through which the larger mass was intruded.

SCHÜRMANN, H. M. E. "Beiträge zur Petrographie der östlichen arabischen Wüste Ägyptens," *Centralbl. f. Min., Geol., etc.*, 1921, 449-58, 481-90.

Very brief descriptions are given of the various igneous rocks of Gebel Mogul, between Gebel Mogul and Um Dalfa, and between Gebel Gharib, Gebel Dara, and Gebel Mogul. Neither chemical analyses nor modal percentages are given, though the various minerals are named. The rocks described are various granitites, pegmatitic granite, hornblende-syenite, and tonalite as plutonic rocks occurring in stocks; pneumatolytic granite, granite-pegmatite, quartz-diorite, and quartz-augite-diorite, plutonic rocks in dikes; pegmatite, graphic-granite, quartz, aplite, riebeckite-aplite, quartz-bostonite, malchite, minette, augite-kersantite, amphibole-vogesite, granite-porphyry, riebeckite-granite-porphyry, and quartz-diorite-porphyrite in dikes; and the following extrusive rocks, also in the form of dikes: granophyre, quartz-porphyry, riebeckite-quartz-porphyry, felsite-porphyry, various porphyrites, andesite, diabase-porphyrite, and diabase.

SCHUSTER, ERNST. "Calcitführende Auswürflinge aus dem Laacher Seegebiet," *Neues Jahrb.*, B. B. XLIII (1919), 295-318, pls. 2.

The calcite-rich ejected blocks of the Laacher Sea region which occur in the leucite-phonolite-tuff are alkali syenites which must have formed the country rock in the deeps. The calcite is regarded as a magmatic mineral, as is also cancrinite and the rare calcium apatite. The rocks may be called calcite-pegmatites and calcite-syenites. In other fragments melilite was developed as well as calcite.

SEDERHOLM, J. J. "On Synantetic Minerals and Related Phenomena. (Reaction Rims, Corona Minerals, Kelyphite, Myrmekite, etc.)," *Bull. Comm. Geol. Finlande*, No. 48, 1916. Pp. 148, pls. 8, figs. 14.

Synantetic minerals are those which are characteristic at the contact between two definite minerals in igneous rocks, kelyphite rims being one form. Myrmekite is applied to intergrowths of plagioclase and vermicular quartz. In this paper the various forms and the different minerals occurring are discussed in great detail, and the literature is fully summarized.

SHAND, S. J. "The Pseudotachylyte of Parijs," *Quart. Jour. Geol. Soc.*, LXXII (1917), 198-221, pls. 4, figs. 13.

In the granite from the neighborhood of Parijs, Orange Free State, there occur abundant veins and networks of a dense black rock, to which, from its resemblance to tachylite, the name pseudotachylite is given. Numerous sketch maps and two photographs show the nature of the occurrence in the field, and eight photogravures show the appearance as thin sections. The rock is very opaque, due to innumerable inclusions of very fine black specks of magnetite. In some of the widest veins there is less magnetite but many polygonal spherulites of dark-brown color in a felt of feldspar-microlites. Several analyses are given. The writer concludes that the pseudo-tachylyte originated from the granite itself through melting, which was caused, not by shearing, but by shock or gas-fluxing.

SHAND, S. J. "The Principle of Saturation in Petrography," *Geol. Mag.*, I (1914), 485-93; II (1915), 339-40.

Mr. Shand replies to certain critics of his system of classifying rocks on the basis of saturated or unsaturated minerals. (The former minerals are those which are stable in the presence of free silica under magmatic conditions, the latter those that are unstable.)

SHAND, S. J. "A System of Petrography," *Geol. Mag.*, IV (1917), 463-69.

Gives further ideas as to desirable features in a classification of rocks. Shand proposes the following factors: (1) degree of saturation, giving five divisions; (2) the double ratio of Or-Ab-An, giving about eight families within each division; (3) the color ratio, giving from two to ten, but preferably four groups in each family; (4) crystallinity, giving two sub-groups within each group; (5) ratios of specific minerals or groups of minerals, giving the types to which "specific" names will be attached; (6) trivial characters of mineralogy and texture, giving varieties.

SHAND, S. J. "The Norite of the Sierra Leone," *Geol. Mag.*, V (1918), 21-23.

Describes two norites from Sierra Leone. One an olivine-rich norite, belongs to 2312 (new form) of the reviewer's classification; the other melanocratic, and without olivine, belongs to 3312.

SHANNON, EARL V. "Petrography of Some Lamprophyric Dike Rocks of the Coeur d'Alene Mining District, Idaho," *Proc. U.S. Nat. Museum*, LVII (1920), 475-95, pls. 3.

The various dike-rocks from the Coeur d'Alene district, collected by Ransome, Calkins, and Umpleby, are here classified and described. Among the rocks are various minettes, spessartites, and vogesites, and one odinite. From the widespread occurrence of these dikes the conclusion is reached that the district is underlain by a granitic batholith which is so far down that none of the complementary aplite reached the surface. The dikes and ore veins belong to substantially the same period.

SKOETSCH, CARL. "Die Einschlüsse in den Basalten zwischen Godesberg und Remagen," *Centralbl. f. Min., etc.*, 1921, 353-63.

In this paper are described all the different minerals which have been found in inclusions in the basalts of this region, as well as their mode of origin, and the alterations produced in them by the basaltic magma.

SMITH, W. CAMPBELL. "Riebeckite-Rhyolite from Northern Kordofan, Sudan," *Mineralog. Mag.*, XIX (1920), 48-50.

Describes a riebeckite-rhyolite from which certain ancient stone implements found at Beraeis are made. Two specimens of tinguaite dikes from Kadoro, described by Linck, represent the only previously mentioned soda-rich rocks in Kordofan.

SPANGENBERG, K. "Die Einbettungsmethode," *Fortschr. d. Min. Krist. u. Petr.*, VII (1920), 397-458.

Under "Immersion Methods" are included all those methods for determining refractive indices based upon certain appearances at the contact between a known and an unknown medium. Three groups are discussed: (1) Disappearance of the border, (2) Töpler's method of inclined illumination (often spoken of as Schroeder van der Kolk's method); (3) Becke's method of raising or lowering the tube of the microscope. A general summary is given of all methods, the reasons for the phenomena are discussed, the relative accuracy shown, and the cause of variation under different conditions pointed out.

SPANGENBERG, K. "Einige Anwendungen und Erweiterungen der Einbettungsmethode," *Centralbl. f. Min., etc.*, 1920, 352-62, 406-14.

Gives various applications of the immersion method.

STEIDTMANN, EDWARD. "Origin of Dolomite as Disclosed by Stains and Other Methods," *Bull. Geol. Soc. Amer.*, XXVIII (1917), 431-50, pls. 7.

Most dolomites were deposited in the sea. A minority were formed by the replacement of limestones by underground waters. Pure dolomites and limestones are far more abundant than mixed beds of limestone and dolomite. The occurrence of calcitic casts in dolomite, or of hollow casts bounded by perfect molds, indicate that the casts were deposited in dolomite. Dolomite rhombs, imbedded in a hornlike impervious mass of fine-grained marine calcite, were evidently formed in the ooze contemporaneously with the calcite.

TARR, W. A. "Oölites in Shale and Their Origin," *Bull. Geol. Soc. Amer.*, XXIX (1918), 587-600, pls. 2, figs. 2.

Describes certain oölites found in shale in the Wind River Mountains, near Lander, Wyoming. They are believed to be due to direct precipitation of colloidal silica by the electrolytic and saline character of the shallow waters into which they were introduced by streams from the adjacent land.

TARR, W. A. "Origin of the Chert in the Burlington Limestone," *Amer. Jour. Sci.*, XLIV (1917), 409-52, figs. 13.

Believes the widespread chert which occurs in the Burlington formation of Mississippian age has been formed from colloidal silica derived from inflowing streams and deposited by electrolytic action. The ellipsoidal form of the chert is attributed to the flattening of the colloidal mass under its own weight and later by the weight of overlying sediments.

TILLEY, C. E. "The Petrology of the Granitic Mass of Cape Willoughby, Kangaroo Island, Part I, *Trans. Roy. Soc. South Australia*, XLIII (1919), 316-41, pls. 2, sketch maps 2.

The granitic rocks of Cape Willoughby, Victor Harbor, and Port Elliot are thought to be chonolites connected below with a single batholith. They were intruded at the close of the orogenic movements in the region. The dominant rock is granite with minor intrusions of aplite and pegmatite. Interesting rocks are the albitites, quartz-albitites, and muscovite-albitites, which are regarded as the final differentiates from the residual magma. The first rock

consists essentially of albitite, with accessory apatite, zircon, and rutile, and with small amounts of muscovite and quartz. The albitite has the character of the "chequer" albite of Flett. The quartz-albitite is similar to the preceding but contains a blue opalescent quartz. The muscovite-albitite contains essential muscovite, some of which is regarded as primary, though some is secondary. The amounts of quartz and muscovite are not stated. The first and third rocks belong to 1112 (new form) of the reviewer's system, the second is 118 if the amount of quartz is over 5 per cent, as it presumably is since these rocks are contrasted with quartz-bearing albitites.

TILLEY, C. E. "The Occurrence and Origin of Certain Quartz-Tourmaline Nodules in the Granite of Cape Willoughby," *Trans. Roy. Soc. South Australia*, XLIII (1919), 156-65, pls. 2.

Certain nodules, consisting essentially of quartz and tourmaline, occurring in an aplite intrusive in granite, are considered as having developed by the replacement of albite and microcline by tourmaline. Says the writer: "Microscopic and other evidence tends to show that they are strictly pneumatolytic products. In the slides is to be seen the very act of replacement of feldspar by tourmaline."

TSUBOI, SEITARŌ. "On the Determination of the Limiting Values of the Medium Refractive Index of a Finely Crushed Biaxial Crystal by the Immersion Method," *Jour. Geol. Soc. Tokyo*, XXV (1918), 38-41, fig. 1.

Maximum and minimum values of refractive indices are readily determinable but the intermediate value must be obtained from a carefully oriented section or be computed. In the latter case the angle between the r axis and one of the optic binormals must be known. In the present paper is given a method of determining limiting values for β , based on the fact that it must always lie between the two values observed in a crystal section of any orientation. By making observations on many grains, the difference between upper and lower limiting values may be made very small. Using basic plagioclase, the author made determinations to 0.003.

TSUBOI, SEITARŌ. "Notes on Miharaite," *Jour. Geol. Soc. Tokyo*, XXV (1918), 47-58, pls. 2.

The term *miharaite* is given to a lava from the volcano Mihara on the island of Oshima, Idzu. It is a basalt characterized by abundant phenocrysts of bytownite with a few of hypersthene and clino-hypersthene, and a very small amount of augite. The groundmass contains labradorite-bytownite microlites,

augite, magnetite, rare apatite, and negligible glass in the gray varieties, and plagioclase and augite in brown glass in the slaggy kinds. Five chemical analyses are given, all giving high SiO_2 (51.94, 51.13, 51.32, 51.40, and 51.45). The rock is given a new name on account of its occult quartz and normative bytownite. Mineral percentages are not given.

TSUBOI, SEITARŌ. "A Diagram for Determining Plagioclases."

Published in the Japanese language in *Jour. Geol. Soc. Tokyo*, XXVII (1920).

Since cleavage pieces of plagioclase are used in determining their refractive indices, a table giving the values in (010) and (001) is of much greater value than the usual one giving α , β , and γ . These values, computed by Tsuboi and plotted as a curve, are reproduced in the reviewer's *Essentials in the Determination of Rock-forming Minerals and Rocks*.

TSUBOI, SEITARŌ. "On a Leucite Rock, Vulsinitic Vicoite, from Utsuryoto Island in the Sea of Japan," *Jour. Geol. Soc. Tokyo*, XXVII (1920), 91-104.

Describes a porphyritic rock with abundant phenocrysts of sanidine and labradorite, the former slightly more abundant than the latter, less hornblende, augite, and titanaugite, and microphenocrysts of biotite, olivine, and apatite. The groundmass consists of laths of orthoclase and plagioclase and round leucites, with prisms and grains of aegirite-augite, some magnetite, and a trifle glass. An analysis is given which, recast into the norm, gives 4.63 per cent nephelite, 39.59 orthoclase, but no leucite. The analysis is readjusted to give leucite with the approximate proportions orthoclase 21.5, albite 42, anorthite 9, leucite 14, diopside 4.5, magnetite 2.8, ilmenite 1.2, apatite 1.1, olivine 2.7, and zircon 0.11. Compared with the description, however, this does not represent the actual mode (in which the plagioclase is stated to be labradorite), consequently it cannot be classified in the reviewer's system.

TSUBOI, SEITARŌ. "Volcano Oshima, Idzu," *Jour. Col. Sci., Tokyo*, XLIII (1920), art. 8. Pp. 148, 24 photomicrographs on 4 plates, map 1, plate profile 1, figs. 42.

Part of this report was published in the preliminary papers described in the second and third preceding articles. Here is given a geological and historical sketch of the volcano Oshima as well as descriptions of the rock types. These are basaltic bandaites, miharaites (which resemble the preceding but have no olivine), and basalt. Various analyses are given, and some beautiful photomicrographs.

A modification of Becke's method for determining $2V$, here given, greatly simplifies the process. The isogyre is first placed parallel to the horizontal cross-hair of the microscope, and the position of the melatope is determined by two angles, one measured in azimuth from the vertical cross-hair to the melatope by rotating the stage, the other measured from the center by means of a graduated eyepiece and any method similar to that employing a Schwarzmann's axial angle scale. The position of the melatope (4) is marked on a stereographic net and a great circle is drawn through it and the ends of the horizontal line. So far the method agrees with that of Becke. Change the conoscope into an orthoscope and rotate the stage until the section is at extinction and read the angle through which the stage was rotated. This locates one of the vibration directions which is now drawn at the proper angle in the projection. Locate, on the great circle previously drawn, the other melatope by means of an angle equal to that between the first melatope and the line representing the vibration direction. Measure $2V$ in the projection. In the older methods it was necessary to observe a second point on the isogyre, which was difficult. In the Tsuboi method only the position of the melatope is needed. Further, there is no need of using the refractive index in the new method. In Becke's original, five great circles were necessary, and in Wright's modification, four. In Tsuboi's, only one great circle is drawn, and one straight line.

TYRRELL, G. W. "A Contribution to the Petrography of Benguella, Based on a Rock Collection Made by Professor J. W. Gregory," *Trans. Roy. Soc. Edinburgh*, LI (1916), 537-59, pl. 1.

Benguella is one of three provinces of the Portuguese West African colony of Angola. Chemical analyses and complete descriptions are given of the rocks, which are granite, charnockite, dellinite, nephelite-sodalite-syenite, akerite, shonkinite, solvsbergite, ouachitite, and various basic intrusives. The two "charnockites" of Table I are $227'$ (new form of reviewer's system) or monzonitonalites (granodiorites in limited sense), while the type charnockite from India is $226'$, or typical granite. The hornblende-hyperites belong to 3312 , as they should. The granite of Table II is $216'$, typical granite; the granodiorite is $227'$, granodiorite in sense usually used but better monzo-tonalite. The two dellinites computed in Table IV are $227'$ for the Angola rock, and $227''$ for the one from Sweden. That is, the former is the extrusive equivalent of a granodiorite, while the latter is the extrusive equivalent of a quartz-monzonite. The shonkinite of Table V is 2113 , which is not according to definition of shonkinite as originally give by Pirsson, for in that the dark constituent must form more than half the rock, consequently it must be in Class 3, as actually is the type Montana specimen given in the same table. The Angola rock falls into the group with pulaskites although the feldspathoid in the latter rock was given by Williams as nephelite or its decomposition product analcite.

TYRRELL, G. W. "Further Notes on the Petrography of South Georgia," *Geol. Mag.*, III (1916), 435-41.

Describes various rocks from South Georgia. The sediments are slates and phyllites, arkoses and grits. The igneous rocks are epidiorite, dolerite, basalt, alaskite, quartz-felsite, lavas and tuffs of doubtful affinities, epidosite, and augitite. So far as petrographic evidence goes, the question whether South Georgia belongs to Suess' "Southern Antilles," or whether it is a remnant of an old sunken continental land remains unsettled.

TYRRELL, G. W. "The Petrography of Arran," *Geol. Mag.*, III (1916), 193-96.

Pitchstone xenoliths in a basalt dike throw some light upon the question of the temperature of lavas. The phenocrysts of quartz have suffered hardly at all, the andesine has had a softening on the margins and fissuring in the interiors, while the orthoclase shows fusion around the margins and along cleavages, producing a yellow or grayish glass, differing from that of the groundmass. The temperature of the intruding lava is therefore thought to have been between 1170° C. and 1375° C.

TYRRELL, G. W. "Some Tertiary Dykes of the Clyde Area," *Geol. Mag.*, IV (1917), 305-15, 350-56, figs. 3.

Describes a dike-rock consisting of phenocrysts of anorthite in a groundmass of labradorite, enstatite and augite, and much glass. The glass indicates orthoclase, silica, and albite. Chemically this rock approaches andesite, from which it differs in its more basic phenocrysts. It is here called *Cumbraite*. It differs from Thomas and Bailey's *Innimorite* in containing enstatite as well as augite. While the name *cumbraite* is proposed by Tyrrell, he says: "Whether these terms should obtain a circulation outside the discussion of the British Tertiary petrographic province is a question beyond the scope of this paper. My own opinion is that they should not."

TYRRELL, G. W. "The Trachytic and Allied Rocks of the Clyde Carboniferous Lava-Plateaus," *Proc. Roy. Soc. Edinburgh*, XXXVI (1917), 288-99.

Among the lavas of the Scottish Carboniferous, true andesites and rhyolites are absent, trachyte and allied rocks are present in subordinate quantities, while basalts predominate. In this paper are brief descriptions of albite-bostonites, albite-trachytes, albite-keratophyres, bostonites, keratophyres, quartz-keratophyres, felsite, and phonolite. Ten analyses, one of bostonite previously unpublished, are given.

TYRRELL, G. W. "The Igneous Geology of the Cumbrae Islands, Firth of Clyde," *Trans. Geol. Soc. Glasgow*, XVI (1916-17), 244-74, figs. 5.

Most of the igneous rocks of the Cumbraes are of Lower Carboniferous age. They are predominately basaltic and originally covered from 2,000 to 3,000 square miles.

TYRRELL, G. W. "The Picrite-Teschenite Sill of Lugar," *Quart. Jour. Geol. Soc.*, LXXII (1917), 84-131, pls. 2.

The Lugar sill in the west of Scotland is found to be made up of a complex of rocks belonging to the analcite series. It forms a mass 140 feet thick and was intruded into cold rocks, as shown by chilled contacts at top and bottom, giving a fine-grained teschenite for a thickness of 10 feet. Beyond the margins, both top and bottom, the rock passes into coarse teschenite. In the interior the sill is divided into at least three bands by some process of differentiation or by successive intrusions, giving first a band of ultra basic rock—picrite and peridotite of coarse texture—occupying the major part of the whole mass. The picrite forms the upper part of the ultrabasic stratum, the peridotite the lower. Above the picrite is a band about 10 to 15 feet thick of fine-grained, basic, nephelite rock of the theralite family. Overlying the picrite, in places, is a peculiar rock to which the name *lugarite* has previously been given. It appears to be intrusive in the picrite, for veins of similar material traverse the latter rock in various places. Three of the teschenites are 2319' of the reviewer's system, and two are 3320, the difference being the absence of orthoclase and the predominance of the dark constituents in the latter. Two chemical analyses are given as well as five more calculated from Rosiwal measurements. Two lugarites are 2320. (A rock described as lugarite in *Geol. Mag.*, 1915, 363, is here called a lugarite-like rock. It is 2218'.) One chemical analysis and two calculated analyses from Rosiwal measurements are given. As for the cause of the differentiation, the author thinks that the hypothesis of sinking of heavy crystals is well attested in the Lugar magma as a whole, but that the differentiation took place prior to its emplacement. The material was injected in successive intrusions, the teschenite first in cold rocks and formed the fine teschenite borders. While still cooling, but probably already solid, the picrite was intruded along its center plane. Here differentiation took place mainly by the sinking of olivine-crystals. Later, while probably still partly liquid, it was intruded by a small mass of lugarite.

VELDE, LUISE. "Die silikatischen Einschlüsse im Basalte des Bühls bei Kassel," *Abhandl. d. Senckenberg. Naturf. Gesell.*, XXXVII (1920), 111-35, pls. 4.

The silicic inclusions in the Bühl basalt in many cases preserve the characteristics of the original rocks from which they were derived, namely, sandstones

and slates. The great majority of the rocks are strongly metamorphosed and in them have been developed sillimanite, corundum, spinel, magnesium-diopside, scapolite, cordierite, and plagioclase. In this work the various inclusions are petrographically described and several chemical analyses are given. The most abundant inclusions are quartz-sillimanite.

C. H. BEHRE, JR.

VOGT, J. H. L. "Die Sulfid-Silikat-Schmelzlösungen," *Norsk. Geologisk Tidsskrift*, IV (1917). Pp. 97, figs. 13, and several tables and analyses.

VOGT, J. H. L. *Die Sulfid-Silikat-Schmelzlösungen: Die Sulfid-schmelzen und die Sulfid-Silikatschmelzen*. Christiania, 1919. Pp. 131, figs. 45, and numerous tables and analyses.

The first of these two papers is essentially a résumé, written in 1917, of extensive work on sulphide-silicate solutions, giving the results obtained to the date of its publication. The second paper presents in detail the data of the earlier one, and embraces additional facts gleaned through two more years of work on the same subject; it is more detailed than the earlier publication and will be reviewed here first. The reviewer believes that with such comprehensive work as this, adequate abstracts are impossible. He strongly advises a careful perusal by metallographers, economic geologists, geochemists, and physical chemists. He wishes to commend the completeness of these studies.

Previous experiments have shown that certain sulphides, such as Sb_2S_3 , Bi_2S_3 , and Ag_2S , have a lower melting point than even those silicates with the lowest melting points. Other sulphides, such as those of lead, copper (Cu_2S), and iron (FeS) and pyrrhotite, have melting points about like those of the least refractory silicates and slightly higher than some of the eutectic mixtures of silicates with low melting points. Other sulphides finally, such as those of zinc, manganese, barium, and calcium, have melting points markedly higher than those of the more common natural silicates. Under-cooled sulphide mixtures or solid solutions of sulphides (sulphide glasses) are unknown.

From a study of the latent heat of fusion it appears that the sulphides PbS , Ag_2S , Cu_2S , FeS are not highly polymerized. It is found, further, that Fe_3O_4 is only slightly soluble in melts of Cu_2S ; this is corroborated by the crystallization sequence as observed in magmas, for magnetite (and ilmenite) crystallize very early indeed from a pyrrhotite- or pyrite-bearing magma. Silicates are soluble in FeS or Cu_2S melts to only a very minor degree.

After a study of the relations between the various sulphides and their eutectics, the writer demonstrates that a eutectic is also possible in solutions of calcium sulphide (or manganese sulphide) in various silicates, such as melilite

and olivine. For example, in sulphide-rich melts with melilite, much of the mass of sulphide crystallizes out before the corresponding spinel, and the remainder crystallizes synchronously with the spinel.

In a solution of calcium magnesium silicate, calcium sulphide in the amount of 2.3 per cent lowers the melting point about 50° . By calculating the molecular depression it is found that polymerization of the sulphides of calcium and manganese in silicate melts is essentially nil; in fact, in the silicate solutions an extensive electrolytic dissociation more probably takes place.

Somewhat similar results as to the presence of a eutectic in solutions of zinc, aluminum, and iron oxides are discussed. In a melt bearing zinc sulphide, zinc spinel, and melilite, the order of crystallization follows the order of naming, as above; if, however, olivine be present instead of melilite, and only a very little sulphide, the order of crystallization is spinel, olivine, and sulphide.

In other slags the presence of copper and its relation to chondri-like structures, and to iron sulphide-bearing silicate solutions were studied. An interesting feature is the concentric arrangement of iron sulphide inclusions in hexagonal plates of biotite. From these observations it is found that Cu_2S is wholly insoluble or at best only slightly soluble in silicate melts rich in iron sulphide—attributable possibly to the presence of a common ion. Various conclusions drawn in this part of the investigation are interesting not only to the geochemist, but to the metallurgist as well.

Some space is also devoted to the crystallization of apatite and ore—the so-called “telechemical” minerals—those only distantly related to the silicate minerals.

The foregoing facts may be gleaned from the publication of 1919. The paper of 1917 briefs most of these observations, and adds considerable material on the part of sulphides in eruptive magmas—an application of physical chemistry to systematic petrogenesis.

Pyrite appears to crystallize very early from magmas, and has a higher melting point than magnetite. Pyrite generally precedes pyrrhotite in the normal sequence of crystallization; it also precedes chalcopyrite, which generally follows magnetite when all three sulphides crystallize from a melt. As previously observed, magnetite is only very slightly soluble in pyrite-rich melts; hence iron oxides are rare or absent in such melts.

A study of the norite-type magmas leads to the conclusion that the predominant mineral generally crystallizes first; thus, in plagioclase-rich norite, plagioclase is automorphic; in olivine-plagioclase, plagioclase-rich rock, plagioclase; in olivine-rich olivine-plagioclase rocks, olivine is automorphic, and so on. The physical chemistry of the several systems normally present in a gabbro-norite magma is summarized, and the writer believes in a eutectic for rocks of the gabbro-norite group, this eutectic, however, being expressed by a line, rather than by a point.

The rather constant appearance of pyroxenites and peridotites in close association with nickel-pyrrhotitic deposits, as at Sudbury, is thought to be

indicative of a eutectic mixture. Various conclusions regarding the order of crystallization in such magmas are drawn from petrographic data. The crystallization temperature for the normal norites is calculated (estimated) to lie between 1200° and 1300° at an atmosphere's pressure. From norite magmas acid dikes are distinct differentiation products, hence very generally associated with nickel-bearing norite. Petrographically the writer seeks to establish in such basic rocks (of the picrite-norite series) the increase of the nickel content with increase in hypersthene or bronzite; all the nickel deposits associated with peridotite have an exceptionally high nickel content.

The sulphides in the norite masses are supposed to be precipitated from the melts with decreasing temperature and then to settle to the bottom; the small amount of sulphides remaining later crystallized with the silicates and was not wholly segregated.

This work has demonstrated: (1) that the origin of nickel-pyrrhotite deposits may be explained by the laws affecting a system liquid-liquid; (2) that the leucocratic acid pyritiferous dikes correspond to the end-product of crystallization in a noritic magma bearing a slight amount of free quartz; (3) that the numerous occurrences of a chalcopyrite-rich sulphide mixture in locally distributed veins, especially such as are limited to the border phases of the rock, depend upon the fact that the chalcopyrite was concentrated in the end magma through progressive solidification of the sulphide constituents.